

***Iotonchium cateniforme* n. sp. (Tylenchida: Iotonchiidae) from Fruiting Bodies of *Cortinarius* spp. and Its Life Cycle**

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Iotonchium cateniforme n. sp. is described. This species possesses four adult forms; mycetophagous female, infective female, parasitic female, and male. The mycetophagous females inhabit in the stipes of fruiting bodies of *Cortinarius subalboviolaceus* and of two *Cortinarius* spp. Males and infective females were also obtained from these fruiting bodies. The parasitic females inhabit in haemocoel of the fungus gnat *Exechia dorsalis*. The mycetophagous female has a long uterus containing many eggs, being different from that of other previously described *Iotonchium* species. *Jpn. J. Nematol.* 29(1) : 24–31 (1999).

Key words: *Cortinarius*, fungus gnat, *Iotonchium*, mycetophagous female, parasitic female.

In the course of field survey on the host ranges of *Iotonchium unguatum* (1), the causal agent of gill-knot disease of the oyster mushroom (*Pleurotus ostreatus*), authors discovered another new species of *Iotonchium* from fruiting bodies of *Cortinarius* spp. in Kyoto, Japan. *Iotonchium cateniforme* n. sp. possesses both mycetophagous and parasitic life cycle as do *I. unguatum* (1, 14, 16) and *I. californicum* POINAR (10). The present paper provides a description of the new species and its life cycle.

MATERIALS AND METHODS

Mushrooms fruited at Mt. Yoshida, Kyoto were collected during summer and autumn, 1998. They were chopped into small pieces and placed on BAERMANN funnels to recover nematodes. From fruiting bodies of three *Cortinarius* species, a great number of *I. cateniforme* n. sp. were detected. Two of the three *Cortinarius* species were collected in July, October, and November, and determined to belong to the subgenus *Sericeocybe* by Dr. Shin-nosuke MIYAUCHI. The other one was collected in October and November and identified as *C. subalboviolaceus* HONGO (Fig. 1). The nematodes obtained from these fruiting bodies were mycetophagous females, infective females, and males.

The fruiting bodies were placed on a 2–3 cm thick layer of vermiculite bed in a wide-mouthed glass bottle or in a plastic cup covered with a screen net and kept at 20°C with a moderate humidity. Insect adults emerged from the bed were dissected in 0.9% NaCl solution. Parasitic female nematodes were found in the haemocoel of the fungus gnat emerged from the bed. The gnat was identified as *Exechia dorsalis* STAEGER (Diptera: Mycetophilidae) (Fig. 2) by Dr.

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Fig. 1. Fruiting body of the fungus (*Cortinarius subalboviolaceus*) for mycetophagous cycle of *Iotonchium cateniforme* n. sp.

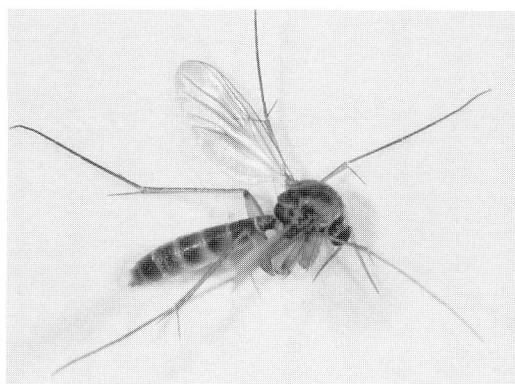


Fig. 2. Insect host (*Exechia dorsalis*) of *Iotonchium cateniforme* n. sp.

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For taxonomic studies, nematodes were killed in hot water (55°C), fixed in TAF, and processed to glycerin (11).

Iotonchium cateniforme n. sp.

(Figs. 3 and 4)

MEASUREMENTS

See Table 1.

DESCRIPTION

Mycetophagous female (Fig. 3A). Long and thick nematode, straight or slightly curved ventrally when relaxed; cuticle smooth; lateral field indistinct, but visible under oil immersion; head rounded; cephalic framework divided into eight sectors; stylet with distinct anterior cone portion, well developed shaft with two guiding rings and three basal knobs extended laterally; dorsal gland orifice opens near stylet base, subventral gland orifice opens within a stylet length behind stylet base; oesophageal glands distinct, overlapping non-muscular oesophagus, anterior intestine and sometimes ovary tip; junction of oesophagus and anterior intestine located just posterior to subventral gland orifice and anterior to nerve ring; junction of anterior and mid intestine located posterior to nerve ring and excretory pore; hemizonid located just anterior to excretory pore; deirid inconspicuous; ovary outstretched, uterus long with many eggs containing juveniles, oviparous, post-uterine sac absent; vulva a wide transverse slit; tail rounded with pointed tip.

Infective female (Fig. 3B). Long and slender, usually straight when relaxed, cuticle with transverse annulations can be seen under oil immersion; lateral fields distinct, not areolated; head dome-shaped; cephalic framework indistinct; stylet with distinct anterior cone portion and shaft, basal knobs indistinct but thickenings usually present; oesophagus and oesophageal glands inconspicuous; deirids located at level of excretory pore, anterior to hemizonid; ovary outstretched, uterus extensive packet with spermatozoa in fertilized females; vagina short, thick walled; vulva a transverse slit; vulval opening not covered with cuticler flap; post vulval uterine

MEASUREMENTS

Table 1. Measurement of *Iotonchium cateniforme* n. sp.

Character	Holotype	Males	Infective females	Mycetophagous females	Parasitic females
n		14	15	15	10
L (mm)	0.75	0.72±0.04 (0.67–0.78)	1.45±0.06 (1.34–1.54)	2.85±0.42 (2.02–3.46)	2.22±0.22 (1.88–2.46)
a	31.9	31.9±4.4 (25.9–38.3)	75.4±5.4 (67.4–84.9)	28.2±2.0 (25.1–31.6)	30.6±2.6 (27.9–36.8)
b*	—	—	—	14.8±1.7 (11.4–17.2)	—
b'	—	—	5.6±0.5 (4.7–6.4)	—	—
c	28.1	29.0±2.6 (24.9–33.8)	11.1±0.7 (9.8–12.0)	479.7±113.7 (309.7–652.0)	28.3±3.9 (22.9–34.8)
c'	1.9	1.8±0.16 (1.5–2.1)	9.7±1.0 (8.4–11.7)	0.19±0.03 (0.14–0.25)	2.2±0.2 (1.9–2.6)
V/T	—	—	83.1±0.9 (81.4–84.6)	99.1±0.2 (98.9–99.5)	89.2±0.6 (88.2–90.4)
Stylet	—	—	11.3±0.7 (10.0–12.6)	10.9±0.4 (10.2–11.6)	9.0±0.8 (8.0–11.0)
Nerve ring-ant. end	82.5	79.2±4.6 (74.4–91.9)	127.8±7.1 (114.2–141.6)	122.8±7.7 (108.0–134.5)	97.3±12.2 (80.5–126.5)
Hemizonid-ant. end	99.6	97.8±6.2 (89.5–109.5)	148.4±6.8 (138.1–161.4)	161.1±11.2 (140.7–175.2)	—
Excretory pore-ant. end	84.9	76.8±6.0 (67.4–89.8)	99.9±4.3 (90.2–107.4)	167.6±11.6 (147.8–182.3)	86.6±13.6 (69.0–116.8)
Deirids-ant. end	84.2	76.4±7.8 (64.6–95.4)	99.7±4.3 (94.0–103.9)	—	—
Junction of oesophagus and ant. intestine-ant. end	—	—	—	25.0±0.8 (23.2–26.3)	—
Ovary±(testis) terminus-ant. end	182.3	229.5±79.1 (132.7–332.7)	644.7±31.1 (584.1–690.3)	142.7±21.6 (115.0–196.5)	118.3±42.5 (62.8–206.2)
Tail	26.7	24.9±1.6 (21.1–27.0)	131.7±10.4 (118.6–155.8)	6.3±1.7 (3.5–9.7)	79.6±11.9 (69.0–97.3)
Greatest body diam.	23.5	22.9±3.0 (18.2–26.7)	19.3±0.9 (18.0–21.1)	101.5±16.4 (71.7–120.4)	72.9±8.0 (62.0–82.0)
Body diam. at vulva	—	—	16.5±0.7 (15.6–17.8)	56.3±6.0 (40.7–64.6)	58.7±4.9 (51.3–64.6)
Body diam. at anus	14.0	14.1±0.9 (12.3–15.4)	13.6±0.7 (12.6–15.1)	33.0±5.0 (23.0–40.7)	37.0±3.8 (31.0–44.2)
Proximal arm of spicule	17.7	17.2±0.7 (15.7–18.2)	—	—	—
Distal arm of spicule	6.7	6.7±0.3 (6.3–7.4)	—	—	—
Bursa	55.4	50.0±4.3 (42.1–55.1)	—	—	—

All measurements are in μm , except L.

*Body length/distance from anterior end to junction of anterior and posterior intestine.

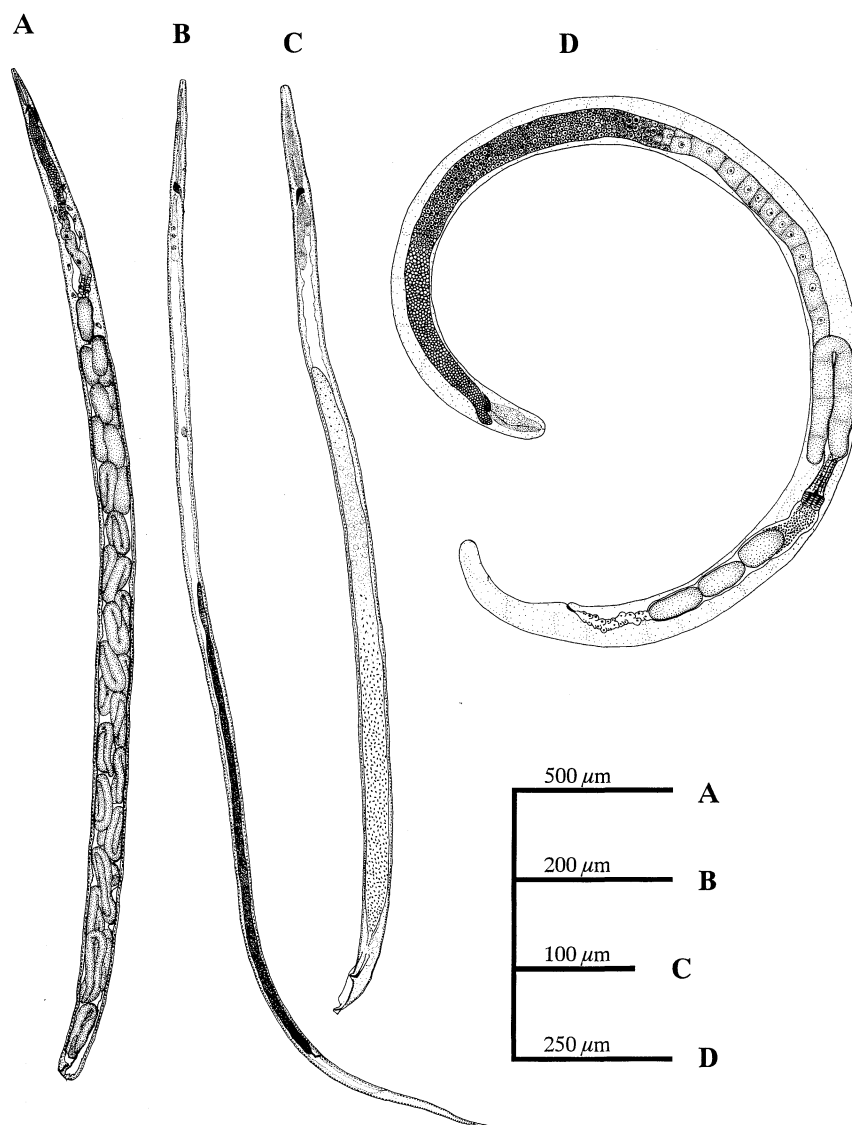


Fig. 3. *Iotonchium cateniforme* n. sp. A: lateral view of mycetophagous female; B: lateral view of infective female; C: lateral view of male; D: lateral view of parasitic female.

sac absent; tail elongate-conoid, with a pointed tip.

Male (Fig. 3C). Shorter but wider than infective stage female; body curved ventrally when relaxed; cuticle with fine transverse annulations; lateral fields distinct; head symmetrical, tetralobed, four minute papillae present; stylet present but inconspicuous; oesophageal gland presents; deirids located at the level of excretory pore and nerve ring, anterior to hemizonid; testis outstretched; vas deferens filled with spermatozoa; bursa elongate, peloderan proximally open, with fine transverse striae; spicules shaped like right-angled L, composed of two sectors, a proximal and a distal arms, both of which can occur within the cloacal chamber although the tips of the distal arms are frequently exerted; proximal arm of spicule with a shaft expanded at the

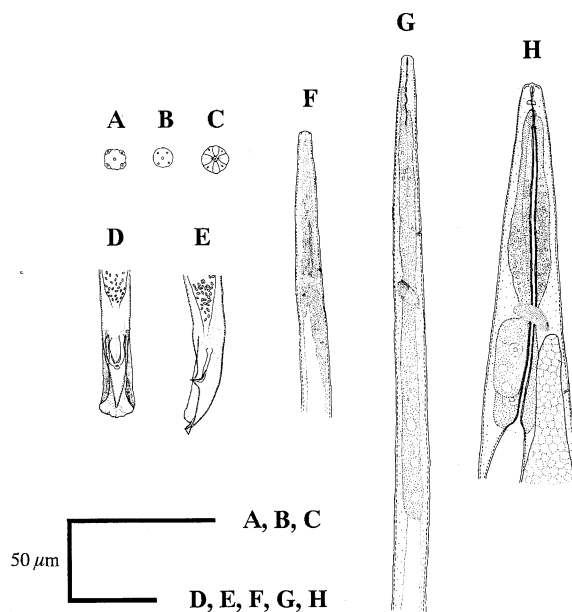


Fig. 4. *Iotonchium cateniforme* n. sp. A: en face view of male; B: en face view of infective female; C: en face view of mycetophagous female; D: ventral view of spicule; E: lateral view of spicule; F: head region of male; G: head region of infective female; H: head region of mycetophagous female.

base; distal arm of spicule wedged; gubernaculum and bursal papillae absent; tail elongate-conoid, with pointed tip.

Parasitic female (Fig. 3D). Length larger than that of infective female, body cylindrical, ventrally coiled when relaxed; cuticle with faint transverse annulation, lateral fields inconspicuous; stylet present but inconspicuous; excretory pore located anterior to nerve ring; ovary outstretched and frequently reflexed at the posterior 1/3 part of the body; oviparous, with several eggs in the uterus, spermatozoa packeted in the anterior part of uterus; vagina short; post vulval uterine sac absent; tail cylindroid with rounded terminus.

TYPE HOST

Fungus gnat, *Exechia dorsalis* STAEGER (Diptera: Mycetophilidae); mycetophagous cycle feeding on *Cortinarius subalboviolaceus* HONGO.

TYPE LOCALITY

Under *Quercus serrata* MURRAY in Mt. Yoshida, Kyoto, Japan.

TYPE SPECIMENS

Holotype (slide No. 9932) and paratypes (slide No. 9933-9986) deposited in the Nematode Collection at the Laboratory of Environmental Mycoscience, Graduate School of Agriculture, Kyoto University, Kyoto, Japan.

DIAGNOSIS AND RELATIONSHIPS

Iotonchium cateniforme n. sp. possesses four adult forms in its life cycle; mycetophagous female, infective female, parasitic female, and male. Only two species in this genus, *I. californicum* POINAR and *I. ungulatum* (1, 14, 16) have been known to possess both mycetophagous and

parasitic cycle.

The body length of mycetophagous females of *I. cateniforme* n. sp. (2.0–3.5 mm) is longer than those of *I. californicum* (0.9–1.5 mm). Upon relaxation, mycetophagous females of *I. cateniforme* n. sp. take straight form, whereas those of *I. unguatum* take ventrally curved and C-shaped one. *I. cateniforme* n. sp. can be distinguished from *I. californicum* and *I. unguatum* based on the morphological features of mycetophagous female gonad; in *I. cateniforme* n. sp., the uterus comprises most part of the gonad and contains many (about 10–30) eggs with juveniles and some developing embryos, whereas the uterus is short and contains only a single egg in *I. californicum*, and the uterus contains some embryonic eggs in *I. unguatum*.

The body length of infective females of *I. cateniforme* n. sp. (1340–1540 μm) differs from those of *I. californicum* (1500–2040 μm), *I. fungorum* (BÜTSCHLI) FILIPJEV & SCHUURMANS STEKHOVEN (2770–3700 μm), *I. cephalostrictum* MEYL (974–1135 μm), and *I. mycophilum* MEYL (1791–1997 μm). The length of males of *I. cateniforme* n. sp. (673–779 μm) is shorter than those of *I. californicum* (810–1230 μm), *I. unguatum* (1030–1270 μm), *I. fungorum* (940–2150 μm), *I. bifurcatum* T. GOODEY (1000–1490 μm), and *I. macrospiculatum* (MEYL) J. B. GOODEY (999–1313 μm). The size and shape of spicules separate *I. cateniforme* n. sp. from other previously described *Iotonchium* species except *I. mycophilum* in which no males were described. The right-angled L-shaped spicule of *I. cateniforme* n. sp. is shared by *I. cephalostrictum* and *I. imperfectum* (BÜTSCHLI) COBB. The spicule of *I. cateniforme* n. sp. (proximal arm = 17.2 μm , distal arm = 6.7 μm) is shorter than that of *I. cephalostrictum* (proximal arm = 22 μm , distal arm = 10 μm). The distal arm tip of the spicule is pointed in *I. cateniforme* n. sp., whereas those are blunt or rounded in *I. cephalostrictum* and *I. imperfectum*. *I. cateniforme* n. sp. can be distinguished from *I. californicum*, *I. unguatum*, *I. fungorum*, *I. bifurcatum*, *I. macrospiculatum*, and *I. cephalostrictum*, based on the position of excretory pore and hemizonid of infective females and males. Excretory pore opens anterior to the hemizonid in the present new species, whereas it opens posterior to the hemizonid in the latter five species. The symmetrical, tetralobed head of males separates *I. cateniforme* n. sp. from other *Iotonchium* species except *I. mycophilum* whose males unknown.

Iotonchium cateniforme n. sp. can be distinguished from *I. californicum* based on the morphological and reproductive features of matured parasitic females. In *I. cateniforme* n. sp., parasitic females are oviparous and do not evert their uterine cells, whereas those of *I. californicum* are ovoviviparous and evert their posterior uterine cells. The matured parasitic females of *I. cateniforme* n. sp. (1880–2460 μm) is shorter than *I. unguatum* (4360–5310 μm). The absence of four minute papillae at head region of parasitic females separates *I. cateniforme* n. sp. from *I. unguatum*.

The species name “*cateniforme*” was named after “chain-like form” embryos in the uterus of mycetophagous females.

LIFE CYCLE

The life cycle of *I. cateniforme* n. sp. appears to be similar to that of *I. californicum* (10) and *I. unguatum* (1, 14, 16). In the fruiting bodies of three *Cortinarius* spp., mycetophagous females, infective females, and males are found. They were detected mainly from the stipes of fruiting bodies. Since no sperm could be observed in the reproductive tract of mycetophagous females, it is concluded that reproduction is performed by parthenogenesis as is the case for *I. californicum*

and *I. unguatum*. Judging from the body sizes of juveniles, they seem to remain in the eggs until the second or third stage. In water, the juveniles emerged from the eggs immediately after being oviposited at room temperature.

Fertilized infective females were obtained from fruiting bodies where males and infective females may mate.

When larvae of the host fungus gnat, *E. dorsalis*, pupated in vermiculite beds, fertilized infective females were supposed to enter the gnats' body cavity. The adult fungus gnats emerged about 1 week after pupation at 20°C. In the insect haemocoel, fertilized infective females developed into matured parasitic females and deposited many eggs. The parasitic nematodes were recovered from both female and male gnats. The nematode juveniles hatched in the haemocoel are supposed to invade the host reproductive organs, and to be deposited on the fruiting bodies by so-called "mock-oviposition" of the gnats.

REMARKS

The mycetophagous females of *I. cateniforme* n. sp. have the same features to *I. unguatum* and *Hexatylus viviparus* in such characteristics as stylet shape and prominent oesophago-intestinal junction locating anterior to nerve ring (Fig. 4H) (8, 12, 13, 15). POINAR (10) also stated that the mycetophagous females of *I. californicum* possess morphological features common to *Hexatylus* species. The phylogenetic relationship between the genera *Iotonchium* and *Hexatylus* is remained to be clarified.

Males of all previously described *Iotonchium* species have asymmetrical dorsoventrally flattened heads. This is one of the diagnostic characters for the genus *Iotonchium*. Male of *I. cateniforme* n. sp., however, has a symmetrical tetralobed head which is considered to be protomorphic. *I. cateniforme* n. sp. has another important diagnostic characters for the genus *Iotonchium*, e.g. L-shaped spicule and absence of gubernaculum.

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和文摘要

フウセンタケ属菌の子実体から検出された *Iotonchium cateniforme* n. sp. の記載

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フウセンタケ属菌の子実体から検出された *Iotonchium* 属の線虫を記載した。*Iotonchium cateniforme* n. sp.の成虫ステージには菌食態雌、感染態雌、雄、昆虫寄生態雌の4態が存在する。菌食態雌、感染態雌、雄はウスムラサキフウセンタケ他2種のフウセンタケ属菌の子実体から得られた。昆虫寄生態雌は、それらの子実体から羽化したキノコバエ科の一種 *Exechia dorsalis* の血体腔内に生息していた。また、菌食態雌の生殖器官の形態は既知種のそれとは顕著に異なっていた。